UNIVERSITI SAINS MALAYSIA

First Semester Examination
2012/2013 Academic Session

January 2013

EAP 581/4 –Water Supply Engineering

Duration : 3 hours

Please check that this examination paper consists of **SEVEN (7)** pages of printed material before you begin the examination.

Instructions : This paper contains **SIX (6)** questions. Answer **FIVE (5)** questions.

All questions must be answered in English.

Each question **MUST BE** answered on a new page.

1. (a) Water consumption may be different for different parts of the world. This may be due to several factors. Discuss **FIVE (5)** factors that may affect the amount of water consumed.

[5 marks]

(b) You are appointed as an adviser to a newly formed water supply authority to advice on the possible methods of determining water demand. Elaborate and discuss your suggestions.

[5 marks]

(c) Population data for certain area are shown in Table 1. Calculate the projected population in the rural areas in 2040 using the following methods:

i. Arithmetic
ii. Geometric
iii. Incremental increase and
iv. Decreasing rate of increase

Table 1

Year	1980	1990	2000	2010
Total population	50,000	65,000	85,000	120,000
Percentage of urban population	30	35	38	42

[10 marks]

2. (a) Rapid mixing for coagulation could be in the form of mechanical or hydraulic mixing system. If you are a consultant for the proposal of the coagulation process for plant production of 120 million litres per day (MLD), with the aid of a sketch diagram suggest detailed mechanism of the system you are going to propose. Also provide appropriate justifications to the client with the advantages and disadvantages of the mechanical and hydraulic systems that you proposed.

[10 marks]

(b) Head loss through over and under baffle system of flocculation tank is 0.215m at a flow rate of 10,000 m^3/day. The temperature of water is 15^0C. At this flow rate the retention time in the flocculation tank is 25 minutes. Calculate:

i. Velocity gradient and Camp Number.

ii. The velocity gradient and Camp Number when the flow rate is changed to 15,000 m^3/day at 20^0C.

Given that:

At 15^0C, absolute viscosity is 1.140×10^{-3} kg/ms and density is 999.1 kg/m^3.
At 20^0C, absolute viscosity is 1.005×10^{-3} kg/ms and density is 998.2 kg/m^3.

[10 marks]

3. (a) Briefly describe the advantages and limitations of dissolved air flotation for potable water treatment.

[5 marks]

(b) Under ideal settling behaviour of sedimentation class II, it will involve settlement of dilute suspensions of flocculent particles. Briefly explain the settling behaviour.

[5 marks]

(c) Figure 1 shows a reticulation system. Estimate the flow rate in each pipeline using Hardy-Cross Method and Hazen-William formula up-to two iteration. Adopt Hazen-Willian coefficient C as 100. Use an initial flow rate of 60 litres per second (lps) from point A to B. The lengths and diameters for pipes AB,

BC, CD and AD are as follows:

Pipe AB: length = 1000m and diameter = 250mm
Pipe BC: length = 700m and diameter =200mm
Pipe CD: length = 800m and diameter =200mm
Pipe AD: length= 900m and diameter = 250mm.

Use the following equation:

$$H_L = \frac{12.25x10^9}{D^{4.87}} L\left(\frac{Q}{C}\right)^{1.85}$$

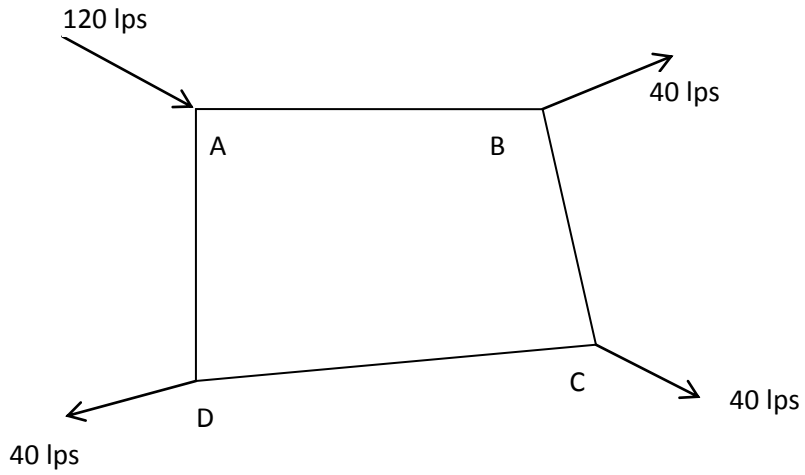

Figure 1

[10 marks]

4. (a) Briefly describe **FIVE (5)** factors that are required for effectiveness of chlorination process in potable water treatment.

[5 marks]

(b) If you are employed as a water treatment plant engineer, suggest on the properties of filter media that are required for an effective filtration process.

[5 marks]

(c) Rapid gravity sand filtration is made up of dual media. It is composed of 0.3m anthracite (mean size of 2.0mm) that is placed over a 0.6m layer of sand (mean size of 0.6mm) with a filtration rate of 9.5 m/hr. Assume the grain sphericity φ is 0.75 and porosity for both media is 0.40, estimate the head loss of the filter at 15^0C where the density and dynamic viscosity are 991.1 kg/m^3 and 1.140×10^{-3} kg/ms. Use the following equation:

$$\frac{h}{L} = \frac{k\mu}{\rho g} \frac{(1-\varepsilon)^2}{\varepsilon^3} \left(\frac{a}{V} \right)^2 v$$

k is dimensionless Kozeny constant, 5 for sieve openings, 6 for size of separation

[10 marks]

5. (a) Briefly discuss **TWO (2)** biological water quality parameters.

[4 marks]

(b) Explain water quality standard in Malaysia with respect to colour, turbidity and temperature.

[6 marks]

(c) Estimate the total OH^-, CO_3^{2-} and HCO_3^- alkalinity in mg/L $CaCO_3$ for the following sample (shown in **Table 2**), if the titrant used is 0.02N H_2SO_4 and the sample volume is 50ml. Report your results in mg/l $CaCO_3$.

Table 2

Sample	Total ml titrant to reach end point	
	Phenolphthalein	**Methl Orange**
V	0.0	10.5
W	15.4	28.2
X	8.2	16.3
Y	6.3	6.4
Z	12.2	29.8

[6 marks]

(d) It is necessary to distinguish the infectious water-related diseases in water supply. A water-related disease is related to impurities in water. Describe the common waterborne pathogens and their associated diseases.

[4 marks]

6. (a) Briefly and explain QUAL2K Model that can simulate the water quality in the certain river, area or catchment.

[4 marks]

(b) Calculate BOD – DO in flowing river, some useful mixing concept & model equations can be defined.

i. Derive the model equation for complete mixing
ii. Derive the model equation for mixing in a river with effluent discharge.

[8 marks]

(c) A point source and a receiving stream at sea level have the following characteristics (Table 3) :

Table 3

Values	Point source	River
Flow (m^3/s)	0.49	5.88
Temperature (^oC)	32	29
DO(mg/l)	2	6.5
DO saturation (mg/l)	6.9	7.3
DO deficit (mg/l)	4.9	0.8

Perform mass balances for temperature and oxygen assuming complete mixing.

[8 marks]

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